Great Lakes Inventory and Monitoring Network

National Park Service
U.S. Department of the Interior

The Current

Issue 3, Spring 2010

Climate Change and the National Park Service

By Ted Gostomski, Network Science Writer

No doubt you have heard about global climate change by now. It is commonly referred to as "the biggest challenge facing humanity for the rest of our lives," and in truth, it will likely be a big issue facing the lives of future generations as well. Because it is a big issue with global implications, and because its importance has been overshadowed by doubt and mistrust, it is easy for many people to throw up their hands and resign themselves to whatever the future brings. But that is not a position the National Park Service can adopt. Whether or not you believe the data and the predictions, climate change will certainly be something we as National Park Service employees will be talking about far into the foreseeable future. What do the predicted changes mean for Great Lakes national parks? Is there a way for the Inventory and Monitoring (I&M) program to provide "early detection" and information that parks can use to help adapt their management appropriately? We think we can.

What we can do

The I&M program is ideally suited to helping parks interpret and plan for climate change and climate-related management. In fact, in her briefing to the 2nd Century Commission – the nongovernmental group formed to evaluate the National Park Service and make recommendations for our work as we approach our centennial in 2016 – NPS Climate Change Response Coordinator Dr. Leigh Welling said, "Adapting to climate change will require a stronger integration of science into management decision-making." That sounds a lot like the I&M program's over-arching goal of "improving park management through greater reliance on scientific knowledge." It is true that our monitoring data can give parks information they need, but climate change is just one of many issues that concern us. Our monitoring programs were not specifically designed with climate change in mind (though it was one consideration). But we are focused on critical resources ("vital signs") that are vulnerable to change regardless of cause, so we do not have to make large leaps to incorporate anticipated climate change impacts, such as decreases in lake levels and changes in vegetation and wildlife, and analyze our data with an eye toward those impacts. Consider the following examples.

Spring break-up on Lake Superior, Apostle Islands NL. NPS photo.

Example 1: Scientists have shown that the average length of winter freeze has been decreasing. The first freeze is occurring later, and the last freeze is occurring earlier, thus lengthening the growing season. A longer growing season with higher average

(Continued on page 2)

2010 Field Schedule

BC - bioaccumulative contaminants (eagles and fish)
LCLU - land cover/land use
VEG - vegetation
WQ - water quality

Apostle Islands NL
- Bill Route *et al.* (BC-eagles)
- Joan Elias (WQ)

Grand Portage NM
- Joan Elias *et al.* (WQ)
- Mark Sandheinrich *et al.* (BC-fish)

Indiana Dunes NL
- David VanderMeulen (WQ)
- Jim Wiener *et al.* (BC-fish)

Isle Royale NP
- Rick Damstra (WQ)
- Mark Sandheinrich, Ted Gostomski *et al.* (BC-fish)
- Suzy Sanders, Jessica Grochowski *et al.* (VEG)
- Ulf Gafvert, Al Kirschbaum (LCLU)

Climate Change and the National Park Service

(Continued from page 1)

temperatures could create ideal conditions for southern plant species to move north and northern species to move farther north or die out. Models show that a 9-degree Fahrenheit increase in annual average temperature will cause forest species composition in the Apostle Islands to change from a northern hardwood/boreal mix (e.g., red oak, sugar maple, white pine, balsam fir, paper birch, yellow birch, and aspen) to a more southern forest type (e.g., white ash, hickory, bur oak, black oak, and white oak). Some models show paper birch possibly disappearing from the area altogether. Additionally, a longer season of warmer temperatures could allow for more than one breeding cycle per year for insect pests, leading to increased damage to forest plant communities.

Our *vegetation monitoring* staff are documenting the composition of forest plant communities, creating a baseline against which to measure future changes. They are also documenting the occurrence of forests pests, so changes in the rate or frequency of infestation will be detected early, giving parks the opportunity to implement integrated pest management protocols if necessary.

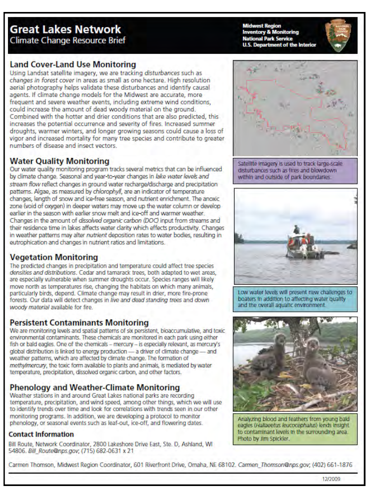
Example 2: Scientists have shown that warmer air temperatures are causing declines in the amount of lake ice cover and how long that ice remains on a lake. This leads to an increase in evaporation of surface water. Shallower, ice-free lakes receive more incident sunlight, which means they stay warmer than lakes that are ice-bound during the winter. Increased water temperatures enhance overall productivity in lakes, which could increase the growth of undesirable species, such as algae blooms. Also, warm water holds less dissolved oxygen than cold and may ultimately limit the amount of suitable habitat available for coldwater fish.

Our *water quality monitoring* staff are measuring water temperature, dissolved oxygen, and water level (among other things) during each visit. Notes are kept on the appearance of the water, which includes documenting algae blooms. If changes are noted in any of these parameters, parks might choose to initiate a specific study of what is causing them and then determine appropriate management actions.

Preserving the past, glimpsing the future

Making informed decisions based on long-term monitoring data is just one way the Great Lakes Network parks are meeting the challenge of climate change. As always, though, there are more questions than answers. How will a park look different? How will it sound different? How will people interact with the land differently when they visit a park? These, too, are questions our monitoring data will help to answer as we move forward in our work.

It is difficult to know for sure what the future holds. The national parks are not immune to the changes we see everywhere else, but they still offer a glimpse of both the past and the future. It is our job to ensure they continue to do so. ●



Great Lakes Network
Climate Change Resource Brief

Midwest Region
Inventory & Monitoring
National Park Service
U.S. Department of the Interior

Land Cover-Land Use Monitoring
Using Landsat satellite imagery, we are tracking *disturbances* such as *changes in forest cover* in areas as small as one hectare. High resolution aerial photography helps validate these disturbances and identify causal agents. If climate change models for the Midwest are accurate, more frequent and severe weather events, including extreme wind conditions, could increase the amount of dead woody material on the ground. Combined with the hotter and drier conditions that are also predicted, this increases the potential occurrence and severity of fires. Increased summer droughts, warmer winters, and longer growing seasons could cause a loss of vigor and increased mortality for many tree species and contribute to greater numbers of disease and insect vectors.

Satellite imagery is used to track large-scale disturbances such as fires and blowdown within and outside of park boundaries.

Water Quality Monitoring
Our water quality monitoring program tracks several metrics that can be influenced by climate change. Seasonal and year-to-year changes in *lake water levels and stream flow* reflect changes in ground water recharge/discharge and precipitation patterns. Algae, as measured by *chlorophyll*, are an indicator of temperature changes, length of snow and ice-free season, and nutrient enrichment. The anoxic zone (void of oxygen) in deeper waters may move up the water column or develop earlier in the season with earlier snow melt and ice-off and warmer weather. Changes in the amount of *dissolved organic carbon (DOC)* input from streams and their residence time in lakes affects water clarity which effects productivity. Changes in weather patterns may alter *nutrient* deposition rates to water bodies, resulting in eutrophication and changes in nutrient ratios and limitations.

Low water levels will present new challenges to boaters in addition to affecting water quality and the overall aquatic environment.

Vegetation Monitoring
The predicted changes in precipitation and temperature could affect tree species *densities and distributions*. Cedar and tamarack trees, both adapted to wet areas, are especially vulnerable when summer droughts occur. Species ranges will likely move north as temperatures rise, changing the habitats on which many animals, particularly birds, depend. Climate change may result in drier, more fire-prone forests. Our data will detect changes in *live and dead standing trees* and *down woody material* available for fire.

Persistent Contaminants Monitoring
We are monitoring levels and spatial patterns of six persistent, bioaccumulative, and toxic environmental contaminants. These chemicals are monitored in each park using either fish or bald eagles. One of the chemicals – mercury – is especially relevant, as mercury's global distribution is linked to energy production — a driver of climate change — and weather patterns, which are affected by climate change. The formation of *methylmercury*, the toxic form available to plants and animals, is mediated by water temperature, precipitation, dissolved organic carbon, and other factors.

Analyzing blood and feathers from young bald eagles (*Haliaeetus leucocephalus*) lends insight to contaminant levels in the surrounding area. Photo by Jim Spickler.

Phenology and Weather-Climate Monitoring
Weather stations in and around Great Lakes national parks are recording temperature, precipitation, and wind speed, among other things, which we will use to identify trends over time and look for correlations with trends seen in our other monitoring programs. In addition, we are developing a protocol to monitor phenology, or seasonal events such as leaf-out, ice-off, and flowering dates.

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For more on how the Network is contributing to climate change monitoring, check out our climate change resource brief at http://science.nature.nps.gov/im/climate/index.cfm

When Students Learn to Monitor

Protection of park resources requires a knowledgeable public. This statement in the NPS Natural Resource Challenge succinctly captures what may be a little-recognized fact: the public has a role in protecting the national parks. The Challenge went on to say that the National Park Service "...must apply innovative techniques to reach out to diverse publics and actively involve them." That was the idea behind the "Linking Research and Education" workshop organized by the Great Lakes Research and Education Center in late 2008. Teachers, resource managers, interpreters, and researchers from most of the nine Network parks came together and each developed a lesson plan based on current research or monitoring occurring in their parks. Network coordinator, Bill Route, Bayfield High School chemistry teacher, Rick Erickson, and Neil Howk and Abby Rambo from Apostle Islands National Lakeshore formed one of the groups, and together they developed a lesson plan based on the Network's monitoring of contaminants in bald eagles at Apostle Islands. The contaminants lesson plan is the first to be fully implemented in a classroom, and it is available for download and use by others from the Great Lakes Research and Education Center website: *www.nps.gov/indu/naturescience/education.htm*.

Route and Erickson shared this lesson plan at a Teacher Discovery Program sponsored by the St. Croix National Scenic Riverway in February. Seventeen educators learned how bald eagles are used to monitor bioaccumulative contaminants in Great Lakes Network parks, how Erickson is teaching his chemistry students about contaminants in the local environment, and how the students themselves are actively collecting and analyzing water samples from some eagle nest sites along the south shore of Lake Superior. "I like students to see what they are learning in school being relevant in the real world," said Erickson. "Here, they learn about practical applications of chemistry and develop good research skills, but they also provide real data towards ongoing monitoring in the Apostle Islands." And that could just be the spark that sets a student on a path they will follow the rest of their lives. ●

Network coordinator Bill Route shows educators why eagles are good indicators of contamination in the environment.

2010 Field Schedule

continued

Mississippi NRRA
- Bill Route *et al.* (BC-eagles)
- David VanderMeulen (WQ)

Pictured Rocks NL
- Jim Wiener *et al.* (BC-fish)
- Park staff (WQ)

Sleeping Bear Dunes NL
- Jim Wiener, Ted Gostomski *et al.* (BC-fish)
- Park staff (WQ)

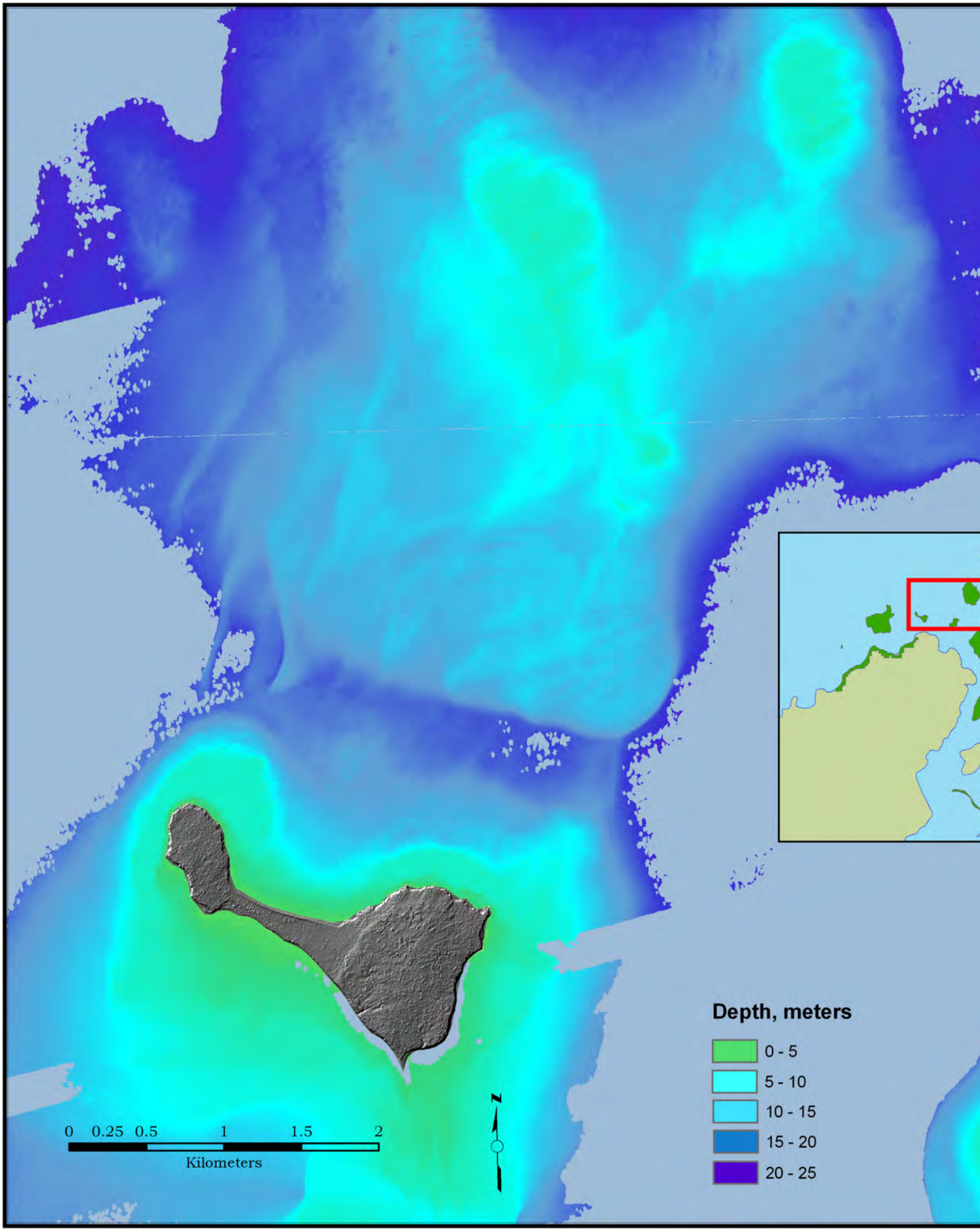
St. Croix NSR
- Bill Route *et al.* (BC-eagles)
- David VanderMeulen (WQ)

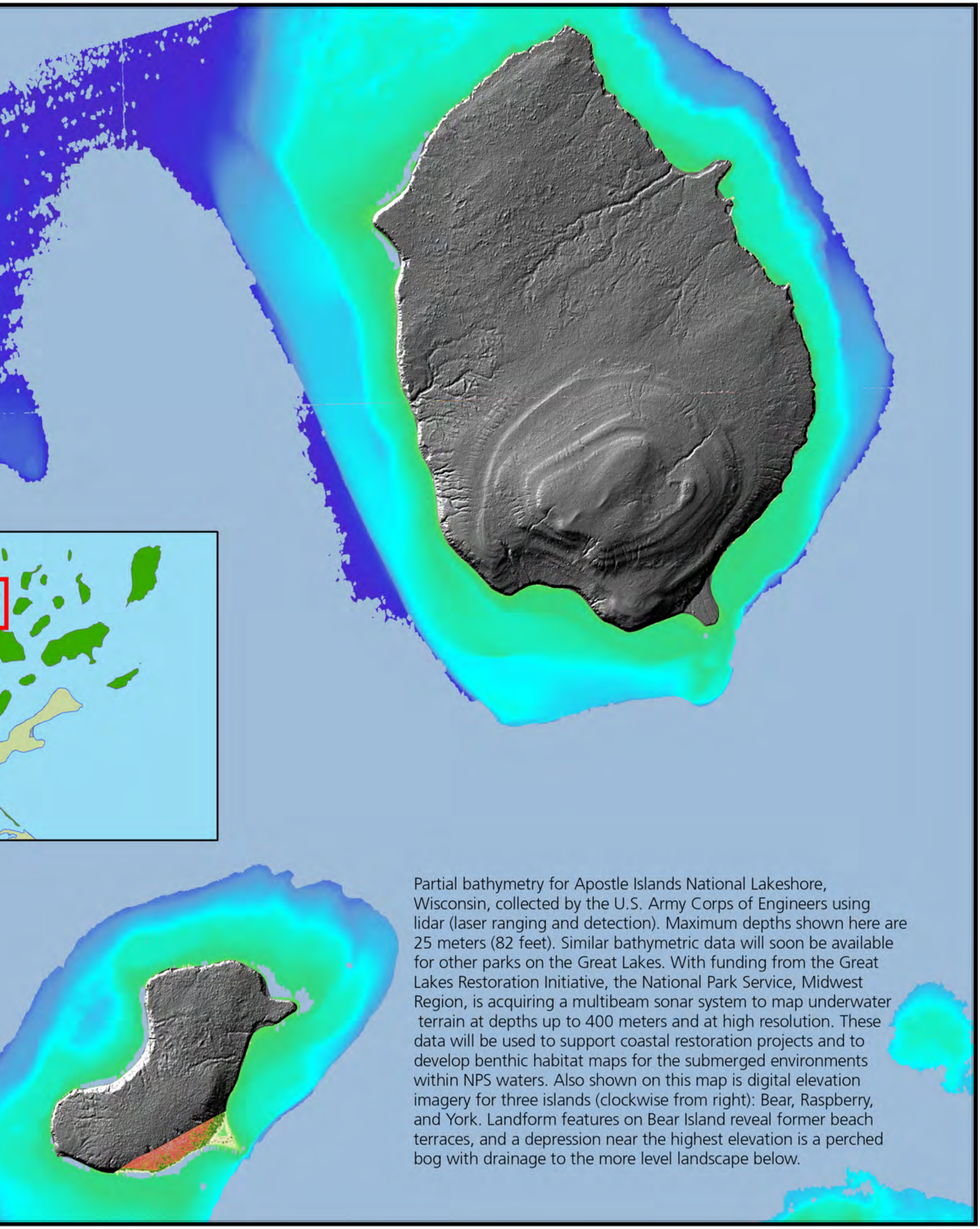
Voyageurs NP
- Mark Sandheinrich *et al.* (BC-fish)
- TBA (WQ)

Staff Insider

Al Kirschbaum, Remote Sensing Specialist

Al Kirschbaum received his undergraduate degree in Forest Science from UW-Madison in 2000. He worked as a research specialist in a UW forest ecology lab until 2003. He then moved to Corvallis, Oregon, to join a remote sensing research lab at Oregon State University, where he helped develop a Landsat-based monitoring protocol for the North Coast and Cascades I&M Network. After finishing this project, Al stayed in the same lab and started his Master's work in remote sensing. His research used Landsat imagery to map mortality in the pinyon-juniper ecosystem of the southwestern U.S. He earned his degree in June 2008. Al joined the Great Lakes Network in July 2008 and is helping develop and implement the Land Cover/Land Use protocol. ●

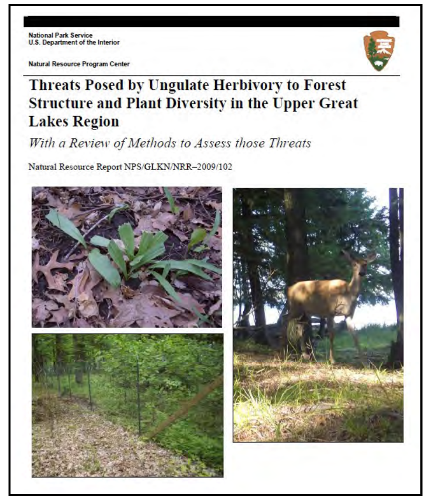

Depth, meters
0 - 5
5 - 10
10 - 15
15 - 20
20 - 25
0
0.25
0.5
1
1.5
2
Kilometers
N



Partial bathymetry for Apostle Islands National Lakeshore, Wisconsin, collected by the U.S. Army Corps of Engineers using lidar (laser ranging and detection). Maximum depths shown here are 25 meters (82 feet). Similar bathymetric data will soon be available for other parks on the Great Lakes. With funding from the Great Lakes Restoration Initiative, the National Park Service, Midwest Region, is acquiring a multibeam sonar system to map underwater terrain at depths up to 400 meters and at high resolution. These data will be used to support coastal restoration projects and to develop benthic habitat maps for the submerged environments within NPS waters. Also shown on this map is digital elevation imagery for three islands (clockwise from right): Bear, Raspberry, and York. Landform features on Bear Island reveal former beach terraces, and a depression near the highest elevation is a perched bog with drainage to the more level landscape below.

Things We're Learning

From *Threats posed by ungulate herbivory to forest structure and plant diversity in the upper Great Lakes region with a review of methods to assess those threats* by D.M. Waller, S. Johnson, R. Collins, and E. Williams. 2009. Natural Resource Report NPS/GLKN/NRR–2009/102. National Park Service, Fort Collins, Colorado.


National Park Service
U.S. Department of the Interior

Natural Resource Program Center

Threats Posed by Ungulate Herbivory to Forest Structure and Plant Diversity in the Upper Great Lakes Region

With a Review of Methods to Assess those Threats

Natural Resource Report NPS/GLKN/NRR–2009/102

Though not actually finalized until 2009, earlier drafts of this report informed the development of the Network vegetation monitoring program's assessment of browse (problem species). However, coming out in a year when Wisconsin hunters were outraged at a second consecutive year of low deer kills during the nine-day gun season, and a state Senator actually called for the firing of anyone in the state's Department of Natural Resources with responsibilities for deer management, the report is timely.

Prior to European settlement, deer overwintering in northern Wisconsin are thought to have occurred at densities of 2-5 animals per square kilometer of suitable habitat. Densities in the 1990s ranged from 8 to >20 deer/km^2. Conversely, Pictured Rocks NL (Michigan) estimates there are 3 deer/km^2 in the park during snow-free months and none (zero!) during the winter. Deep snows are believed to be the causal factor there. Indiana Dunes NL estimates up to 20 deer/km^2. Voyageurs NP, which is close to the northern range limit for deer has densities from 5.1-8.6 deer/km^2.

What does this mean for the landscape in those places? It is known that overabundant deer populations affect forested landscapes in general by altering forest species composition, tree regeneration, vertical structure, understory species dynamics, and species diversity. They also influence the prevalence of invasive plant species, and they may affect nutrient cycling. For example, preferential browsing of one or a few tree species will shift forest composition towards species that tolerate or resist browsing. This has been noted in Michigan's Ottawa National Forest, where deer's preference for hemlock buds, needles, and twigs has shifted the composition of what were hemlock-dominated forests to forests dominated by sugar maple and other hardwoods. The largest impact deer have on trees is preventing regeneration of certain species such as eastern white cedar, hemlock, northern red oak, and yellow birch. Deer are also severely impacting shrubs; their strong preference for Canada yew is completely inhibiting regeneration, as has been documented at Apostle Islands NL.

Deer herbivory also affects the middle and ground layers of the forest. Where deer herbivory is heavy, forest understories can become dominated by one or a few browse-tolerant or resistant species, such as exotic, invasive herbs (garlic mustard or Asian silt grass) and shrubs (common and European buckthorn) and certain native herbs (Jack-in-the-pulpit, enchanter's nightshade, ferns, grasses, and sedges), vines (Virginia creeper), and shrubs (choke cherry). The authors note that the abundance of all of these browse-tolerant species have increased in the Great Lakes states over the past 50 years, concurrent with a decline in overall native plant diversity. A subsequent effect of selectively removing the understory is that both ground-dwelling and shrub-nesting birds are declining as they lose nest sites and become more exposed to predators.

The authors also discuss the effects of moose browsing in Voyageurs NP and Isle Royale NP. On Isle Royale, where there are no deer, moose are having a clear impact on the regeneration of aquatic plants and of balsam fir. However, the moose population there and in Voyageurs is declining, so their impacts on a regional scale are of a smaller magnitude than those of deer.

One outcome of this report is that the Network's vegetation monitoring program has incorporated methods of estimating browse pressure and documenting plant species occurrences, size distributions, and abundances, which can potentially be linked to major forces of change such as herbivore browse pressure and climate change. ●

New and Notable

Phenology Monitoring Protocol Being Considered

Network staff are finalizing a proposal for phenology monitoring methods that will be presented to parks for review and comments. Phenology was on the Network's "long list" of vital signs, but time and funds were not available for its implementation, so it did not make the "short list" of 21 vital signs we are focused on now. Renewed attention came when a park superintendent recommended that phenology be implemented as one way of monitoring climate change. Network terrestrial ecologist Suzy Sanders is leading the effort. She is proposing a very simple program based on nation-wide multi-agency efforts, which use easily observed Spring phenomena such as the complete disappearance of ice on lakes and rivers, bud-burst (the appearance of leaves on trees), and the blooming of common wildflowers in the Network parks. She says, "because these are relatively easy phenomena to observe, we hope the parks can implement these methods with minimal added work load."


A trillium in bloom near Lake Manitou, Sleeping Bear Dunes NL.

Great Lakes Restoration Initiative Funds Will Enhance Monitoring, Improve Inter-Agency Coordination

Two proposals submitted by Network office staff were approved for funding through the Great Lake Restoration Initiative (GLRI). All of these will begin in the summer of 2010.

Making National Park Service expertise available to, and building capacity and support for Lake-wide management plans for lakes Superior, Michigan, and Erie — Many of the goals and objectives of the Lake-wide Management Plans (LaMPs) overlap with those of the NPS. To advance these common visions, goals, and objectives, the NPS will lend its expertise in several capacities for the mutual benefit of the Binational Program and the NPS. Five main components of this project are: 1) increase NPS involvement in the LaMP process; 2) re-establish the decommissioned stream gage on Washington Creek, Isle Royale National Park; 3) assess contaminants in bald eagles; 4) advance capability to monitor amphibians; 5) prepare restoration plans for wetlands and riparian areas and advance capability for wetland monitoring. Network parks involved are APIS, GRPO, INDU, ISRO, PIRO, and SLBE (side-bar). Though not in the Great Lakes Network, Cuyahoga Valley NP and Perry's Victory and International Peace Memorial (both in Ohio and on Lake Erie) are also included.

Monitoring contaminants in Great Lakes national park units— In partnership with the University of Wisconsin-La Crosse, the Network will increase the frequency with which we sample fish and larval dragonflies for contaminants. Samples will now be collected from each of six parks (INDU, SLBE, PIRO, ISRO, GRPO, and VOYA; sidebar) annually over the next four years rather than once every three years as originally planned in the contaminants monitoring protocol .

Network staff are also working with NPS Midwest Region staff to create *bathymetric maps* of all waters within NPS jurisdiction in lakes Superior and Michigan (see center pages of this newsletter for an example). ●

RESTORE GREAT LAKES
GREAT LAKES RESTORATION INITIATIVE
Accountability · Action · Urgency

APIS
Apostle Islands National Lakeshore (Wisconsin)

INDU
Indiana Dunes National Lakeshore (Indiana)

SLBE
Sleeping Bear Dunes National Lakeshore (Michigan)

PIRO
Pictured Rocks National Lakeshore (Michigan)

ISRO
Isle Royale National Park (Michigan)

GRPO
Grand Portage National Monument (Minnesota)

VOYA
Voyageurs National Park (Minnesota)

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Improving park management through greater reliance on scientific knowledge

The Current is published twice a year for Great Lakes Network park staff, our partners, and others interested in resource management in national parks of the Great Lakes region.

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